

CLAIMS

[1] A process for preparing an F<sub>2</sub>-containing gas comprising the steps of:

exciting at least one fluoro compound in a fluoro compound-containing gas by conferring energy on the fluoro compound-containing gas under reduced pressure; and

partially or completely converting the excited fluoro compound-containing gas containing the excited fluoro compound into F<sub>2</sub> under normal pressure or overpressure.

[2] The process for preparing an F<sub>2</sub>-containing gas of claim 1 wherein the step of exciting a fluoro compound is performed in a first zone maintained under reduced pressure; and

the step of converting the gas into F<sub>2</sub> is performed in a second zone communicating with the first zone and maintained under normal pressure or overpressure.

[3] The process for preparing an F<sub>2</sub>-containing gas of claim 1 wherein the step of exciting a fluoro compound is performed in a first zone maintained under reduced pressure; and

the step of converting the gas into F<sub>2</sub> comprises maintaining the pressure in the transportation system under a normal pressure or overpressure condition during transportation of the excited fluoro compound-containing gas to a second zone communicating with the first zone.

[4] The process for preparing an F<sub>2</sub>-containing gas of claim 1 wherein the step of exciting a fluoro compound is

performed in a first zone maintained under reduced pressure; and

the step of converting the gas into  $F_2$  is performed by maintaining the pressure in the first zone under a normal pressure or overpressure condition.

[5] The process for preparing an  $F_2$ -containing gas of claim 1 wherein the step of exciting a fluoro compound is performed in a first chamber maintained under reduced pressure; and

the step of converting the gas into  $F_2$  comprises transporting the excited fluoro compound-containing gas containing the excited fluoro compound from the first chamber to a second chamber maintained under normal pressure or overpressure via a gas channel connecting the first chamber and the second chamber.

[6] The process for preparing an  $F_2$ -containing gas of claim 1 wherein the step of exciting a fluoro compound is performed in a first chamber maintained under reduced pressure; and

the step of converting the gas into  $F_2$  comprises maintaining the pressure in the transportation system under a normal pressure or overpressure condition during transportation of the excited fluoro compound-containing gas containing the excited fluoro compound from the first chamber to a second chamber via a gas channel connecting the first chamber and the second chamber.

[7] The process for preparing an  $F_2$ -containing gas of claim 1 wherein the step of exciting a fluoro compound is

performed in a first chamber maintained under reduced pressure; and

the step of converting the gas into  $F_2$  is performed in the first chamber by maintaining the first chamber under normal pressure or overpressure.

[8] The process for preparing an  $F_2$ -containing gas of claim 5 or 6 wherein a vacuum pump is provided in a gas channel connecting the first chamber and the second chamber and said vacuum pump is used during the step of transporting the excited fluoro compound-containing gas from the first chamber to the second chamber.

[9] The process for preparing an  $F_2$ -containing gas of any one of claims 1 to 8 wherein the step of exciting a fluoro compound comprises ionizing the fluoro compound-containing gas.

[10] The process for preparing an  $F_2$ -containing gas of any one of claims 1 to 9 wherein the fluoro compound is a gaseous fluoro compound selected from linear, branched or cyclic saturated perfluorocarbons, linear, branched or cyclic unsaturated perfluorocarbons, carbonyl fluorides, perfluoro hypofluorides, perfluoro peroxides, perfluoroether compounds, oxygen-containing fluorides, interhalogen fluorides, iodine-containing fluorides, sulfur-containing fluorides, nitrogen-containing fluorides, silicon-containing fluorides, rare gas-containing fluorides, or combinations thereof.

[11] The process for preparing an  $F_2$ -containing gas of any one of claims 1 to 9 wherein the fluoro compound is

selected from  $\text{CF}_4$ ,  $\text{C}_2\text{F}_6$ ,  $\text{C}_3\text{F}_8$ ,  $\text{C}_4\text{F}_{10}$ ,  $\text{C}_5\text{F}_{12}$ ,  $\text{C}_6\text{F}_{14}$ ,  $\text{C}_2\text{F}_4$ ,  $\text{C}_3\text{F}_6$ ,  $\text{C}_4\text{F}_8$ ,  $\text{C}_5\text{F}_{10}$ ,  $\text{C}_6\text{F}_{12}$ ,  $\text{C}_4\text{F}_6$ ,  $\text{FCOF}$ ,  $\text{CF}_3\text{COF}$ ,  $\text{CF}_2(\text{COF})_2$ ,  $\text{C}_3\text{F}_7\text{COF}$ ,  $\text{CF}_3\text{OF}$ ,  $\text{C}_2\text{F}_5\text{OF}$ ,  $\text{CF}_2(\text{OF})_2$ ,  $\text{CF}_3\text{COOF}$ ,  $\text{CF}_3\text{OOCF}_3$ ,  $\text{CF}_3\text{COOOF}$ ,  $\text{CF}_3\text{OCF}_3$ ,  $\text{C}_2\text{F}_5\text{OC}_2\text{F}_5$ ,  $\text{C}_2\text{F}_4\text{OC}_2\text{F}_4$ ,  $\text{OF}_2$ ,  $\text{SOF}_2$ ,  $\text{SOF}_4$ ,  $\text{NOF}$ ,  $\text{ClF}_3$ ,  $\text{IF}_5$ ,  $\text{BrF}_5$ ,  $\text{BrF}_3$ ,  $\text{CF}_3\text{I}$ ,  $\text{C}_2\text{F}_5\text{I}$ ,  $\text{N}_2\text{F}_4$ ,  $\text{NF}_3$ ,  $\text{NOF}_3$ ,  $\text{SiF}_4$ ,  $\text{Si}_2\text{F}_6$ ,  $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{KrF}_2$ ,  $\text{SF}_4$ ,  $\text{SF}_6$ , or a mixture thereof.

[12] The process for preparing an  $\text{F}_2$ -containing gas of any one of claims 1 to 11 wherein the fluoro compound-containing gas comprises an inert gas and/or oxygen.

[13] The process for preparing an  $\text{F}_2$ -containing gas of claim 12 wherein the inert gas is He, Ne, Ar, Xe, Kr,  $\text{N}_2$ , or a combination thereof.

[14] The process for preparing an  $\text{F}_2$ -containing gas of any one of claims 1 to 13 wherein the fluoro compound is one or more members selected from the group consisting of  $\text{NF}_3$ ,  $\text{C}_2\text{F}_6$ , and  $\text{COF}_2$ .

[15] The process for preparing an  $\text{F}_2$ -containing gas of claim 14 wherein the fluoro compound is ionized in the presence of oxygen when it is a perfluorocarbon or a mixture containing one or more perfluorocarbons.

[16] A process for modifying the surface of an article comprising contacting an  $\text{F}_2$ -containing gas obtained by the process for preparing an  $\text{F}_2$ -containing gas of any one of claims 1 to 15 with the surface of the article under reduced pressure or overpressure or normal pressure.

[17] The surface modification process of claim 16 further comprising the step of introducing an inert gas and/or oxygen after conferring energy on the fluoro

compound-containing gas before contacting the gas with the article to be surface-modified.

[18] The surface modification process of claim 16 or 17 wherein the surface modification is performed by fluorinating the surface of the article.

[19] The surface modification process of any one of claims 16 to 18 wherein the article to be surface-modified is one or more members selected from the group consisting of metals, metal compounds and polymers.

[20] The surface modification process of claim 19 wherein the polymer is an article based on polypropylene.

[21] The surface modification process of claim 19 wherein the metal compound is one or more members selected from the group consisting of metal oxides, metal nitrides, metal carbides, metal hydroxides and metal chlorides.

[22] The surface modification process of claim 19 wherein the metal compound is a compound based on Si.

[23] The surface modification process of claim 22 wherein the compound based on Si is Si, SiO<sub>2</sub>, Si<sub>3</sub>N<sub>4</sub>, SiC, polysilicon, amorphous silicon, or a combination thereof.

[24] The surface modification process of claim 22 wherein the compound based on Si is deposited in an LPCVD equipment.

[25] An equipment for preparing an F<sub>2</sub>-containing gas comprising:

a means for ionizing a fluoro compound-containing gas under reduced pressure; and

a pressure controlling means communicating with the

ionizing means and controlling the pressure of the ionized fluoro compound-containing gas at a normal pressure or overpressure condition.

[26] A surface modification equipment comprising a means communicating with the pressure controlling means in the equipment for preparing an F<sub>2</sub>-containing gas of claim 25 and positioning an article whose surface should be contacted with the F<sub>2</sub>-containing gas prepared in the equipment for preparing an F<sub>2</sub>-containing gas under reduced pressure or overpressure or normal pressure.

[27] The surface modification equipment of claim 26 further comprising a vacuum pump or compressor communicating with the means for positioning the article.

[28] A method for using the equipment of any one of claims 25 to 27 to directly fluorinate an organic and/or inorganic material.